

## Tests in progress

An interesting formula for "matching" hearing characteristics that yield optimal subjective results has long been established. Not only for broadband loudspeakers, although these can benefit most from this research.

Of course, it is best when the frequency response of any electroacoustic device covers the entire acoustic band (the range of frequencies heard by humans), but when it has to be limited for technical reasons, it should be done at both extremes, "symmetrically", even at the expense of a more severe narrowing of the frequency response. The foundation of naturalness is, according to this theory, proper placement of the "center of gravity", which gives a perception of balance - in this sense it is not a matter of the uniformity of the response, but its "balance"; even response that is perfectly linear, but truncated only on one side, would be considered less balanced than a much narrower one, falling towards both extremes, but symmetrical.

Accordingly, if a loudspeaker assembly (in particular a broadband speaker) processes from, say, 50 Hz (accounting for the operating conditions in the room), then its bandwidth should end at... 10 kHz, which would not be risked by any designer of a multiway speaker system, even a small monitor. No wonder - anyone who has any experience, even an amateur, knows that it usually does not improve the sound as judged by audiophiles: in "pieces" and not as a whole. Besides, I don't think that even the overall evaluation always confirms the validity of "both-sided" bandwidth trimming.

Hearing tests in progress ...



# Closer Acoustics VIGO GENEROUSLY from 12 inches

Closer Acoustics is a small company, but with a singular perspective and distinctive offerings. In its way their lineup is broad, covering several different categories of equipment, but they mostly concentrate on loudspeakers.

We tested the Flō phono preamplifier only two months ago, and maybe one day we will test the Provocateur integrated amplifier... But now, their largest loudspeakers, Vigo, appear on the scene in two versions - Classic and EX.

Modern loudspeaker technology provides designers - and consequently users - with a wide range of solutions. We use it to please not only our ears but our eyes as well, making loudspeakers small and large, fabulously complex and modest, suiting different tastes in terms of sound, appearance, and different views on the means to achieve the best results. Various options clash, to some extent regardless of these results; some designers are faithful to specific concepts, others are more flexible, but the vast majority sticks to solutions that seem modern, obvious, and necessary - that is, multiway systems. There are so many versions and variants of them that with individual modifications everyone can flash their originality, although many prefer to stick close to safe classics. Multiway systems can be partially active, partially horn, divided into modules... The options could be listed for a very long time, and it is worth noting that each system defined by its configuration and type of drivers can be tuned by the crossover itself in... infinitely many ways, and even the generally correct ones can be very numerous.

However, not everyone is satisfied with these choices and possibilities. Either they do not want to throw their designs into a crowded field, even a very diverse one of multiway designs, or they firmly believe (and hear) that the best results can be achieved by a completely different way, for example the one known from the very beginning of the history of electroacoustic equipment, but rarely used today. Broadband loudspeakers have not been completely forgotten. They have their admirers, among them eminent specialists who bring out from single drivers what is the best in them and what is not available from multiway speaker systems.

Facts and emotions, hopes and prejudices, opinions and experiences mix in this melting pot. And from the particular combination of various factors and dispositions, a conviction blossoms in some audiophiles that differs from that of most.... Some of them remain just users, but some grow up to be designers. That's how a niche is created, in itself meaning little, but the audio world has many such niches, and they contribute to its unique richness, and some of them manage to become more important than their initial potential would suggest - as if a snowball were rolling... For example, who would have guessed 10 years ago that the analog turntable would return in such glory and be so popular? Does the same future await wideband loudspeakers? If some audiophiles have succumbed to their charm, why shouldn't others? At this stage it's just a matter of attitude... Is this encouragement or just the opposite? Neither one nor the other.

Translated from Polish

Closer offers both speakers with a single broadband driver, and also more complex systems which incorporate an additional tweeter. A tweeter can also be added to the Vigo, and this formally creates a two-way system, but one that is unusual enough to be considered a combination of a broadband driver (not a woofer) with a tweeter.

Let's start with the fact that a broadband driver is designed - as the name suggests - to independently process the widest possible bandwidth, covering midrange frequencies naturally and obviously, but with the farthest possible extension towards both low and high frequencies. Depending mainly on the diaphragm diameter, but also on many other parameters (coil diameter; mass, profile and diaphragm material; resonance frequency),

the speaker driver will cope better with low or high frequencies.

A small one will reach high, even close to 20 kHz, but at the bottom it will stop at about 100 Hz, making you think about adding a subwoofer; a large one will go low, but at the top it will lack a lot.

Medium size, typical for conventional midrange drivers, will be the best balanced, but will leave some deficiency at both extremes. The fight for wide bandwidth (from a single driver) also comes at some cost to flat frequency response; achieving a high upper limit frequency does not mean smooth response in this range, but it is better to process up to, say, 10 kHz, than only up to 5 kHz.

And due to the low vibrational mass required for high frequency production it is difficult for a large driver to effectively produce the lowest frequencies with high power - the diaphragms are light, the coils short, the amplitudes moderate. However, the resulting limitations are at least to some extent acceptable in connection with the most common use of broadband speaker drivers,

which require other advantages - they are usually high-efficiency, in turn dedicated to tube amplifiers, so they do not need to have high power. Specialized woofers and low-midrange drivers could also go in this direction (and sometimes do), and so are designed to work in multiway assemblies. Ultimately, how a particular speaker driver is used and filtered depends on the designer of the entire system (not the driver itself); original ideas sometimes lead to surprising results.

12 inches is already an extreme diameter, very large even for a bass-midrange driver, raising reasonable doubts as to whether such an oscillating system can even reach 10 kHz, let alone 20 kHz. EMS declares a 35 Hz - 15 kHz bandwidth for the LB12 MKII driver, without specifying the decibel tolerance, and the frequency response shown in the catalog seem to roughly confirm that. In Closer's information, the frequency response of the Vigo is not given, but nothing should change at the top... until you add a tweeter.

**In the case of the Vigo, we are dealing with a very large speaker driver, but in the intention of both its manufacturer (the French company EMS) and in the way Closer uses it - still a wideband driver.**



But let's go back to the general idea of a wideband driver design. Why limit ourselves to such archaic measures when we have at our disposal a wide range of drivers specialized in particular sub-ranges, which can be used to assemble various multiway combinations, allowing us to achieve response not only reaching 20 kHz, but doing so more evenly?

Wideband drivers are used not only in high-end, sophisticated, niche designs, such as we are dealing with here. Paradoxically, they are also typical of the cheapest audio devices, such as tiny Bluetooth speakers, where there is not room for a larger system or a larger woofer. And since the latter is tiny, it easily becomes broadband... This is, however, a very compromised solution, although a reasonable one in such devices, and has little to do with our problem of establishing the superiority of a wideband speaker over a multiway system in designs intended to achieve the highest quality sound.

The designer and owner of Closer himself, Jacek Grodecki, explains very cogently: "Ideally, we would like to play back the recording with a single sound source that supports the entire range. But this is very difficult". And further: "There are always compromises when designing a loudspeaker. I focused on the character of the message ". Elsewhere in the company's presentation there is a bit about magic, fascination, etc., but conversations with the designer also show that he looks at the situation soberly enough (for a proponent of wideband speakers) and does not promise to solve all the problems and achieve perfection.



Rarely do the leading specialists in wideband transducers attempt to create a 12-inch driver. While the very peaks of the acoustic band have not been reached in this case either, the very good dispersion of the mid frequencies is itself a great success.

The arguments are as follows: There is no need to divide the band into sub-bands, directed to individual transducers, while keeping in mind that it will be difficult for such a combination to achieve response that is as close as possible to the input, and thus linear... But we do not get linear response from a broadband driver either, because it distorts even more than a well-tuned multiway system. We do have a point source of sound - yes, although if we listen to the multiway system from an appropriate distance, the phenomenon of smearing is slight, and coaxial and symmetric systems take care of that definitively.

Finally, the consistency of timbre associated with diaphragm material - sometimes very different in drivers of a multiway system - is ensured here by the work of a single diaphragm, but there are multiway designs with diaphragms of the same material (aluminum), and the often used differentiation of diaphragm materials is not due to technological problems but serves to ensure the best processing of individual ranges.

Closer adds the observation that, after all, when miking individual instruments during recording, one does not use a set of microphones specialized for processing different frequency ranges.... And yet, sometimes miking of e.g., drums with a few different microphones is used, and even more so, different instruments and voices are often miked with different microphones, so the final recording (mix) is a combination of different microphones. And even if only one microphone (or a stereo pair of microphones) was used to record a soloist or an entire ensemble, it's because the microphones have a wide enough bandwidth. And single speakers do not have...

All the arguments promoting wideband speakers, on the one hand, will not convince those who are used to observing and evaluating quality primarily through the prism of frequency response. On the other hand, ... sometimes broadband speakers, with all their objective shortcomings, sound surprisingly good - natural, intense, and at the same time non-fatiguing, so there is something to it. These arguments can work in practice, although they can also be empty promises. A wideband speaker is a jump into deep water - one may turn out to be wonderful, another hopeless, and each of them may be evaluated differently by different listeners; the range of opinions here is even greater than with „normal” loudspeakers.

**Eliminating the disadvantages of multi-way systems and returning to the disadvantages of broadband speakers ... is a free choice of the designer and the user.**



Wideband single driver speakers do not usually have any electrical filters, since they do not need a crossover - no need to divide the frequency band - but these elements can also be used to equalize the driver's imperfect frequency response.

**In the Vigo, the broadband speaker driver is connected directly to the amplifier; there are no electronics in the signal path (except for cables).**

But in the end, it's not as if we're hearing the speaker itself, as the enclosure comes into play, and literally. And in the case of wideband speakers, it is often exceptionally important.... For reasons already outlined, broadband loudspeakers usually do not charge with bass, having high resonant frequencies, and so the enclosure is supposed to support low frequency processing in a more efficient way than with typical loudspeakers, even bass-reflex ones, hence the labyrinth and horn enclosures in various variants often seen in this industry. This is intertwined with yet another story - just like broadband speakers, various large, exotic enclosures come from the old days, when there was a lot of experimentation in this area, and proper tuning of even a relatively simple bass-reflex was a matter of chance and a lot of experience, rather than knowledge available today even to amateurs. Broadband loudspeakers are also sometimes used in open enclosures, encouraged by both their high efficiency and reference to the oldest solutions.

The Vigo case has a long history and is extremely original. The excitement started when we were unable to remove the speaker

- apparently fixed with more than just screws from the outside. When asked how to do it, Jacek Grodecki refused to allow us to look inside. Initially he gave only a very vague explanation of how the cabinet works and did not want to reveal any details, explaining that he wanted to maintain secrecy. However, such an approach could also lead to a suspicion that the enclosure is actually very simple (which would not be ruled out by our measurements), and stories about its complexity and special features are just a marketing ploy, while inside it is "blowing in the wind". From the outside we can see only two bass-reflex openings in the form of slots, located not far from each other, close to the bottom and rear edges (one in the bottom panel, the other in the rear), which looks quite unusual, but does not mean that it works atypically - it could be just a semblance of originality ending not far away. The manufacturer finally agreed to show the internal structure of the case and it turned out that it is indeed an unusual design. Its origins date back to the mid-20th century. When Jacek Grodecki came across this clue, the original design was like a treasure trove for him - an inspiration which encouraged him to experiment and set up his own company. As he says, without this case there would be no Closer.



The terminals are WBT components - the manufacturer did not neglect any detail that might be important for the sound, appearance or even prestige.



The connection socket is located at the very top to keep the connection to the speaker as short as possible; this may not seem very practical as it causes the cable to hang when connected from the outside, but it pays off when installing an external tweeter. The supplied pair of Vigo Classic speakers was made of Mdf, finished with Alcantara, and did not have a rear support.



The Vigo EX are made entirely of plywood and so are the Vigo Classic. The support not only improves stability, it is also an aesthetically harmonious component of an extraordinary enclosure.

**Designers of the past were like sailors discovering new lands with their own experience, unique knowledge, and enormous effort.**

Those were the times before Thiel and Small, whose names became synonymous with a set of parameters allowing for a much faster and correct design of an enclosure - initially closed or bass-reflex. They developed a mathematical basis for determining optimal characteristics for different parameters of the speaker used, and then the development of digital technology and computer simulations made this task even easier, and made this knowledge available to virtually everyone, just like designing crossovers or taking measurements. It also exposed the imperfections of many old ideas, but they did not lose their charm, and some of them were so successful, that it is still worth coming back to them today, especially when you feel like doing something original... Nowadays designers, enamored with perfect tools allowing to achieve good results easily, do not tire in searching for new solutions, and manufacturers are happy, that all we need to be happy is a simple bass-reflex, or a box with a tube, because it is much cheaper than complex labyrinth enclosures, which were created half a century ago.

We can also refer to the more widely known figure of M.J. King, who for many years has been involved in the theory and development of so-called quarter-wave enclosures, that take advantage of the phenomenon of standing waves created when a quarter wave (and its multiples) is placed in a channel. A quarter-wave enclosure is therefore by definition a resonant enclosure, designed to take advantage of the energy from the back of the diaphragm and radiate it in specific ranges, although its operation is sometimes combined with that of a transmission line, whose original, postulated purpose was to damp this energy (similar to a closed enclosure, but in a slightly different manner).

The theory of quarter-wave resonances is also considered in the design of horn enclosures, even intended to amplify energy from the back of the diaphragm. However, if the enclosure is not heavily damped, then in almost every case a bass-reflex system comes into play... A Helmholtz resonator is created, which basically dominates the action of the enclosure, and quarter-wave resonances become just an add-on. And if so, why complicate the enclosure further? In search of even better results. Today this is no longer the domain of the entire high-end, but of such manufacturers as Closer, and such enthusiasts as Jacek Grodecki. From Closer's description it seems that the type of enclosure used is particularly dedicated to the midrange driver and here we can quote, because the company's wording is very apt:

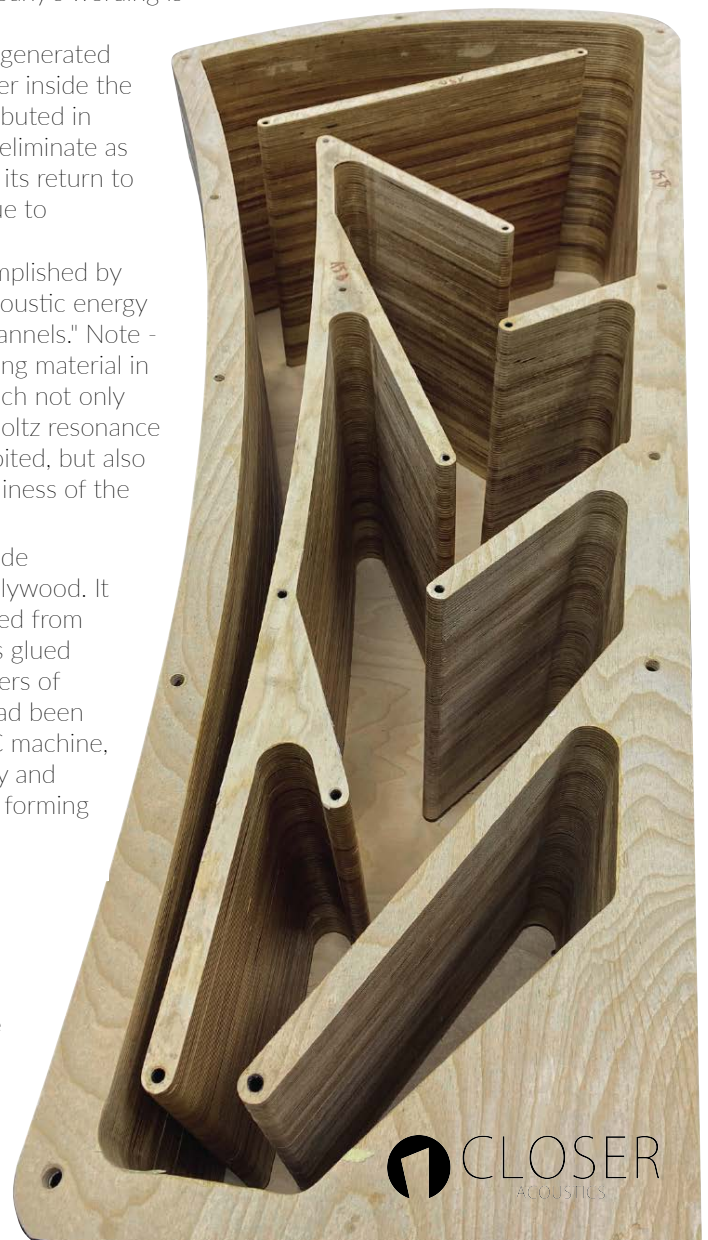
"Acoustic energy generated by the loudspeaker inside the enclosure is distributed in such a way as to eliminate as much as possible its return to the diaphragm due to reflections.

Damping is accomplished by dissipating the acoustic energy in a system of channels." Note - there is no damping material in the channels, which not only allows the Helmholtz resonance effect to be exploited, but also improves the liveliness of the midrange.

The cabinet is made entirely of birch plywood. It can be easily traced from the photo - it was glued together from layers of plywood which had been cut out on a CNC machine, arranged vertically and from side to side, forming channels.

**While the outer form of the cabinet is original and attractive, its interior is even more surprising. The cabinet in the picture is not yet finished - the opening for the driver has not been made in the outer shell.**

An enclosure like this will be very rigid; its front is thick and made across the layers of plywood, and the sides are further strengthened by a layer of Corian. Frankly speaking, concerns about copying such a design are unfounded. It would require too much work and machinery which amateurs do not have. Finally, the external form of the whole - original, rational, and beautiful - fortunately cannot be hidden, but it would also be difficult to copy, because it is closely related to the way the plywood layers are cut and assembled. The form follows the content. The Vigos look stunning. There is no point in further elaborating on its shape because everything is perfectly visible in the picture.



The drivers used in the Vigo Classic and Vigo Classic EX look very similar from the outside, their most distinctive feature being the mushroom-shaped wooden (solid beech) phase corrector. For a broadband speaker this can be a key element, strongly affecting the characteristics at the edge of the band, so its form, although quite attractive, cannot be the product of fantasy, but of much acoustic experience. Coils in broadband speaker drivers are usually small, because both low mass and low inductance favor extended frequency response (although it does not provide much power in the low frequency range). In comparison the coil in the LB12 driver is quite large - it has a diameter of 45 mm. The moving mass is still moderate (37 g), much lower than in woofers of this size, mainly due to the relatively light, cellulose diaphragm suspended in a classic fold. For both versions of the LB12 (MKII in Vigo Classic and EX in Vigo EX), the manufacturer claims the same characteristics in the mid-high range (which will be verified in the Lab). The main difference concerns the drive system and does not come down to the size of the magnet, the height of the magnetic gap or the dimensions of the voice coil. The voice coils are perhaps even the same.

The magnetic system in the LB12 mk II (Vigo Classic) is conventional (ferrite), the force factor BL - very high (20.6 Tm), which is due to both the strong magnet and the concentration of the flux it produces primarily at the height occupied by the coil, which in turn limits the maximum amplitude (the manufacturer quotes 3 mm, but we are not sure if this is +/- 3 mm or peak to peak). Such speakers traditionally rely on high efficiency (here 97.5 dB) rather than high power (here 40 W). Despite the moderate moving mass, and thanks to the high compliance of the suspensions (although upper folded surrounds are often referred to as "hard" or "stiff", it does not have to be that way, especially since the lower spider is more important for compliance), a fairly low resonance frequency,  $F_s = 34$  Hz is established. Together with low mass and very high BL, this also leads to a very low  $Q_{ts}$  (0.21), which predestines this speaker for use in... bass-reflex enclosures.

**The LB12 EX (Vigo EX) uses an electromagnet instead of a permanent magnet. This is also a design from long ago, almost abandoned, and now returning to high-end glory.**

Is it right? Instead of a permanent magnet, there is a second coil around the oscillating coil through which a direct current flows, creating a magnetic field. In the past, the primary advantage of the electromagnet was its ability to produce a strong field (and thus achieve a high BL and the resulting desirable properties), when permanent magnet technology was not yet so well mastered. Today, widely used neodymium magnets, as well as well-designed ferrite magnets, produce magnetic fields quite sufficient to achieve the desired performance. Of course, the larger the magnet, the higher the cost, but the cost of the electromagnet is even higher. Permanent magnets generate some distortion, but electromagnets are not free from distortion either and do not produce perfect magnetic fields as well as their enthusiasts would like. Currently, they are manufactured only by a few niche manufacturers, so it is unlikely that they will improve as permanent magnet designs have via research and development investments by large companies. There remains another attraction of electromagnetic loudspeakers; since the field strength depends on the current flowing through the coil, we can adjust many of the loudspeaker's field-related parameters by adjusting the strength of the current. As BL increases, the efficiency will increase and the  $Q_{ts}$  will decrease. But why adjust the efficiency of a broadband speaker? One would think we would always want it to be as high as possible, so adjusting it lower or higher would be in order to prioritize other parameters.



LB12 MKII looks from the back like a typical high-quality woofer; its magnet doesn't look very powerful, but in this case it's enough to produce BL over 20 Tm.



The LB12 EX has a much deeper... not a magnet, but an electromagnet. Changing the voltage allows for the adjustment of important parameters of the speaker-most importantly the  $Q_{ts}$ .



It makes more sense to have an adjustable Qts in order to create a speaker driver that is very versatile in terms of its ability to be used in different enclosures - of different volumes and in different systems. Qts is a parameter that strongly influences the designer's decisions in this area. A low Qts speaker driver will be suitable for horn and bass-reflex enclosures, a higher one for closed enclosures, and even higher ones for transmission lines (as long as we assume that they will not fire like bass-reflex...) and open enclosure. The influence of Qts value on particular systems is not clear-cut - it's a vast area of knowledge and experience, into which we won't go further here.

**The LB12 EX loudspeaker, with its Qts adjustable from a very low value of 0.21 to virtually any value, can be used in all systems and in a wide range of volumes.**

This is a driver perfect for playing with, for experiments, for gaining experience, for searching for the best solution... Although always somehow limited - by adjusting the field we cannot change the other T-S parameters, such as resonant frequency and equivalent volume (which are derived only from mechanical characteristics, i.e., diaphragm mass and suspension compliance), nor maximum excursion, nor response in the midrange. So, we have a "multivariant" driver but not an "all-variant" one. But what is the point of such a driver for a designer who can freely define the parameters of an enclosure, matching them to a chosen driver with unchanging parameters, or search for a driver with the desired parameters for a specific enclosure?

On the one hand, the choice of transducers available to manufacturers as well as hobbyists today is huge, on the other hand - hardly anyone approaches the subject with a ready-made enclosure, but it can be designed quite freely, so there is no problem matching speaker and enclosure from both sides, and so we don't need to adjust parameters...

And if the bass-reflex enclosure has been carefully designed, it takes into account a particular value of the Qts parameter and should not be changed to any great extent (it will lead to deterioration of the impulse response). It is easier to consider variable Qtc when using a closed enclosure, where quite a large range of acceptable values (derived from Qts) can be found, with different sonic effects subject to individual preference.

Finally, in the case of quarter-wave enclosures which can be, generally speaking, difficult to predict the proper Qts value the driver should have, one with variable Qts might be useful. But variable when the designer is making their own tests, or also in the finished product? Opinions may be divided here - many audiophiles do not like it when a loudspeaker is equipped with any kind of adjustments, as they suggest that the designer is not sure how the speaker should sound. In practice, however, reasonable adjustments are useful, if only because of the influence of room acoustics. Also, adjusting the Qts can help to find the best sound under specific conditions and individual perception.



Enjoying the benefits of the electromagnet speaker requires an external power supply. On its display we can see the regulated voltage. The lowest available value is 1V, but in practice good performance starts at 10V..

The range of Qts adjustment in a speaker driver with an electromagnet can be huge, limited only by the lowest possible value obtained at maximum current (voltage from the power supply). The manufacturer gives different values of Qts for different values of applied voltage. The largest permissible is 15 V, in which case Qts = 0.21 at 97.5 dB efficiency - equivalent to the parameters of LB12 MKII, so using an electromagnet is not a way to achieve even higher BL. Voltage can only be reduced, and at 10 V Qts = 0.29 and efficiency = 96 dB - parameters still suitable for bass-reflex, while at 7.5 V, although the efficiency drops only slightly (to 94.5 dB), the Qts has risen to 0.41. The lowest included voltage is 5 V, where the efficiency drops to 91.5 dB and Qts rises to 0.77 - this is a speaker that would be difficult to use even in a closed enclosure, more suitable for an enclosure with a lossy hole, heavily damped transmission line or open baffle. The Vigo EX's power supply actually produces regulated voltage as low as 1V, which is so low as to be no longer practical.

That's right, a loudspeaker with an electromagnet, LB12 EX or any other, requires the addition of an external power supply.... This further increases the cost and makes the installation inconvenient, although for such inconveniences some audiophiles are not only prepared, but even very willing. In our lab we made a series of measurements for different voltages, which will give us an even better idea of the situation.



## LABORATORY CLOSER ACOUSTICS VIGO

In the first section, we will discuss the performance of the Vigo Classic without the tweeter option. At the outset, however, an explanation of the testing setup for both Vigos is needed. The wide-range driver was placed at a height of 90 cm (its center), as optimal as possible for the height at which the ears of a seated listener will be - the main axis will run there. In our measurements we usually set the main axis at that height, sometimes we will move it 10 cm lower or higher if the driver configuration suggests it. In the case of Vigo Classic there was no such need, but the Vigo EX was also tested with a tweeter whose axis is located much higher - at a height of as much as 125 cm. In such a situation it is difficult to predict at what height the best frequency response will appear, so common sense led us to set the starting point (for the main axis) at 100 cm for both Vigos. Therefore, seemingly surprisingly, in the measurement of the Vigo Classic (and also the Vigo EX without tweeter) the level of the main axis is slightly lower than -7°, where the microphone is closer to the main axis of the wideband driver itself.

The differences mentioned are not large, and so the response on the +7° axis (de facto a larger angle in relation to the main axis of the transducer), and even from the 15° axis (horizontally) reach a high level up to about 7 kHz, and above that they quickly fall on all axes. Only at a horizontal angle of 30° was the frequency response poor, falling off above 2 kHz. For a 12-inch speaker the dispersion in the midrange is very good, thanks to the unusual shape of the phase equalizer, which was a priority for the creator of this speaker. Reaching 7 kHz is also a great achievement for a speaker of this size, despite irregularities appearing above 1.5 kHz. However, the response does not reach 12 kHz,

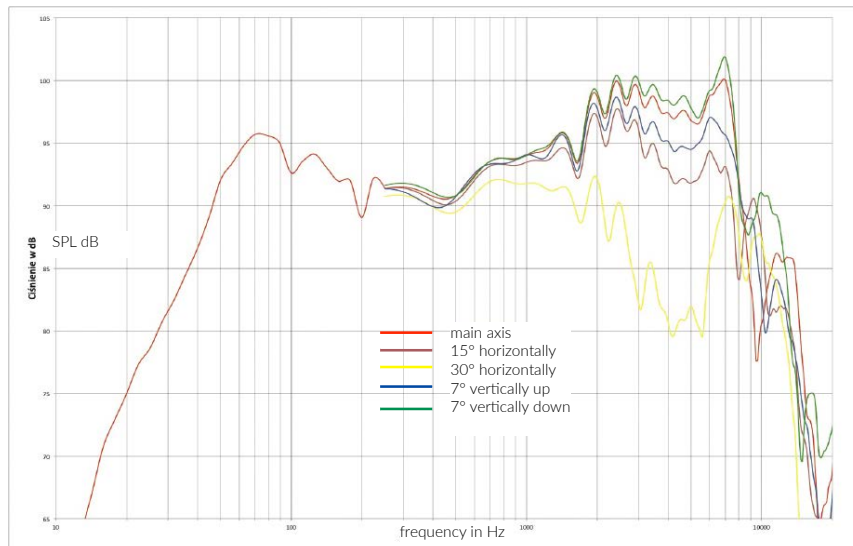


fig. 1. Vigo Classic, frequency response on different axes

as promised by the manufacturer of the LB12 MKII; probably, reducing the coil diameter and adding a small dust cap would give a few more kilohertz. Looking at it from a distance, the LB12 MKII is an interesting woofer, which not only awaits the company of a tweeter, but whose frequency response could, for the benefit of midrange equalization, be corrected - lowered above 2 kHz. On the other hand, low frequencies are processed at least well, a -6 dB drop is noted at 42 Hz. For a broadband speaker, even a 12-inch one, this is a very satisfactory result. Moreover, the slope is relatively smooth (about 12 dB/oct.) down to 20 Hz, which promises a good impulse response. Measured Impedance shows two distinct peaks, typical for a bass-reflex system. However, there are also much smaller ripples in the range of 100-500 Hz, which may result from additional resonances of the complex enclosure. The minima are about 9 ohms; based on that, the nominal impedance is a very high 12 ohms;

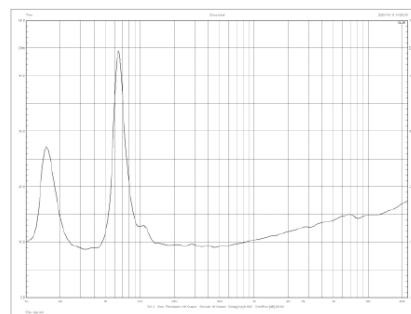


fig. 2. Vigo Classic, (plus tweeter), electrical impedance

sensitivity is 94 dB, which at 12 ohms means 95 dB efficiency. These are excellent parameters to match with a tube amplifier, which does not mean that the audio characteristics of each will blend perfectly into a wonderful sound. Rather, the Vigo will impose its style, and tube coloration will become secondary.

Rated impedance [Ω]	12
Sensitivity (2.83 V / 1 m) [dB] **	94
Power rating [H] *	40
Dimensions (H x W x D) [cm]	120 x 34 x 51
Weight [kg]	49
* according to the manufacturer's data	
** efficiency 95 dB	

The main family of Vigo EX response curves were measured with voltage at the maximum 15V to the electromagnet and without an additional tweeter. Comparing the Vigo Classic, with the LB12 MKII driver versus the Vigo EX, with its LB12 EX, shows that they coincide, as expected - the vibration system is the same. The LB12 EX has a slightly higher level (averaging about 1 dB across the entire bandwidth) and slightly better reproduction of higher frequencies, specifically around 10 kHz. We measured the impedance characteristics of the Vigo EX with the tweeter connected for different electromagnet voltages (1V/6V/12V/15V); as the voltage decreases the resonance peaks in the low frequency range decrease, at 1V the magnetic field is so weak they are almost invisible. The minimum impedance was about 7.5  $\Omega$ , which is about 1.5  $\Omega$  lower than in the Vigo Classic. As a result, we assigned a nominal impedance of 8  $\Omega$ , still most suitable for tube amplifiers. The slightly higher sensitivity of the Vigo EX may be explained by its lower impedance; the efficiency of both designs is very similar: 95 dB. Connecting a tweeter lowered the impedance above 10 kHz, its polarity does not matter.

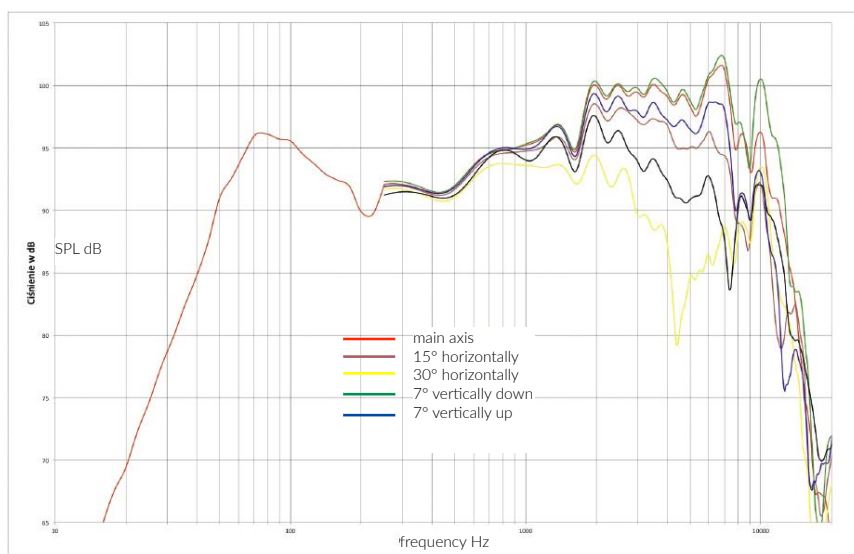


fig. 3. Vigo EX, frequency response on different axes.

Rated impedance [ $\Omega$ ]	8
Sensitivity (2.83 V / 1 m) [dB] **	95
Rated power [H] *	40
Dimensions (H x W x D) [cm]	120 x 34 x 51
Weight [kg]	64

\* according to the manufacturer's data  
 \*\* efficiency 95 dB

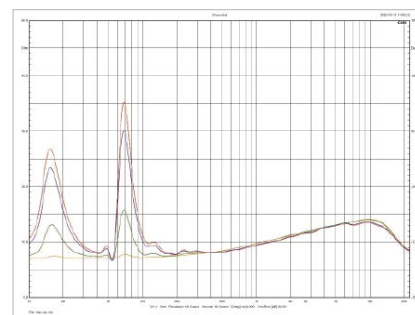


fig. 4. Vigo EX (plus tweeter), electrical impedance



### LABORATORY CLOSER ACOUSTICS VIGO

Adding a tweeter changes the waveform around 10 kHz, but the improvement is not what we hoped for. In the next large picture, we have superimposed three response curves from the main axis (100 cm) - without the tweeter (red), with the tweeter in standard polarization (black) and inverted polarization (blue).

First, integration of the two drivers is difficult for reasons already discussed. Therefore, at each polarization, on each axis, including the major axis chosen for this measurement, different gain and collapse patterns appear on the response curve. The black curve ("factory" polarization) gives a slightly higher level around 5 kHz, and especially much higher in the 11-13 kHz range, while the inverted polarization does so in the 8-11 kHz range. But these ranges are not permanently assigned to specific polarizations, they will change as the axis changes, and on each axis the response will be different, as we are about to observe in the following figures.

Secondly, no polarization on any axis will ensure that the response will reach up to 20 kHz at sufficient level, because apparently the tweeter itself cannot do it. Admittedly, in the figure discussed above, the main axis of measurement was far removed from the tweeter axis (being much closer to the broadband axis), but we also made a measurement on the tweeter axis, shown among measurements for different axes in the following figures (in black). Even then, at 20 kHz we have about 10 dB drop from the average level in the whole bandwidth, and we can also see a weakening above 2 kHz - but this is due to the large angle to the main axis of the broadband driver when measured from a distance of 1 m. In normal listening the distance would be further, the angle smaller and the level higher, but.... no one is going to sit with their head that high anyway. Sticking to the 100 cm height assumed in the measurements, from a greater distance we can improve the high frequency response a little by decreasing the angle of the tweeter's main axis. In two separate large figures we show whole families of response characteristics measured at different angles, with the tweeter connected in standard and inverted polarity.

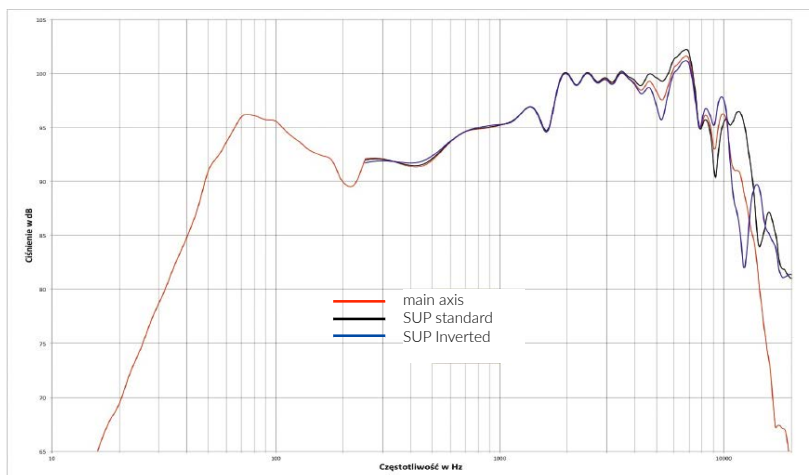


fig. 5. Vigo EX, main axis response without tweeter, with tweeter and with tweeter in inverted polarity, on the main axis..

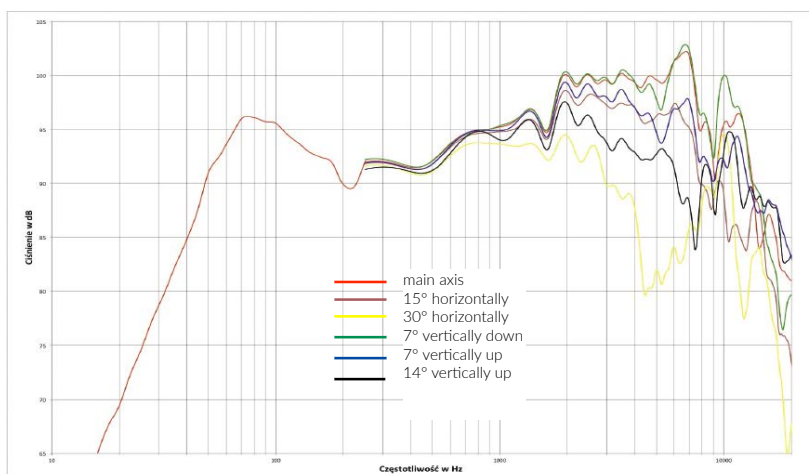


fig. 6. Vigo EX plus tweeter, frequency response on different axes.

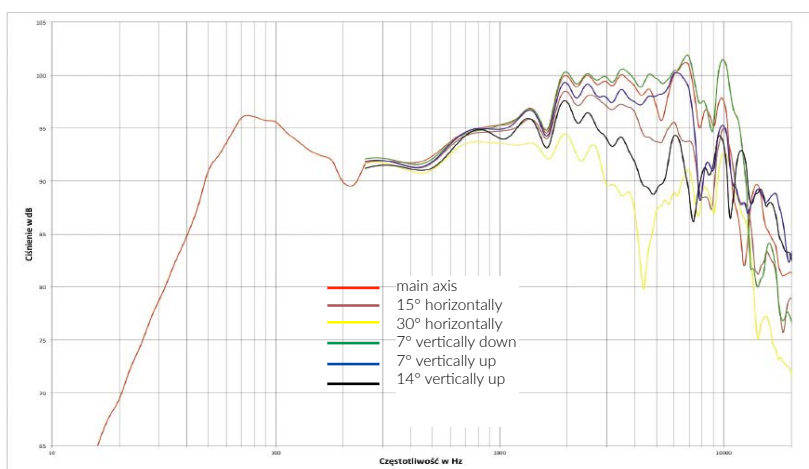
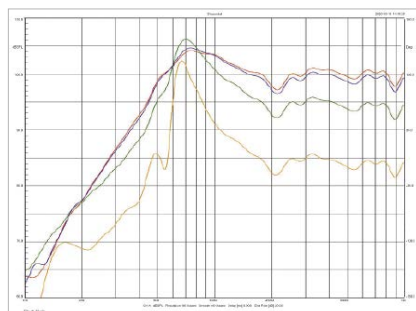


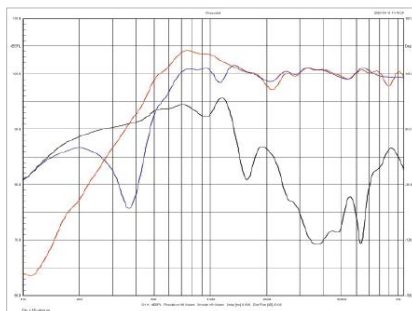
fig. 7. Vigo EX plus tweeter in reverse polarity, frequency response on different axes.



**fig. 8. Vigo EX, low-frequency response at different electromagnet supply voltages**

An additional set of figures deals with low-frequency operation, with measurements taken in the near field. Adjusting the electromagnetic force in Vigo EX, and following important parameters - BL, Qts and efficiency - gives a unique opportunity to observe these changes. Analogous changes would occur if the strength of a classical permanent magnet system were changed. Comparing the maximum voltage of 15 V (red curve) to 12 V (blue curve), the maximum voltage results in the highest level except near the very peak at 70-80 Hz, where 12 V response is half a decibel louder while giving way about 1 dB at higher frequencies.

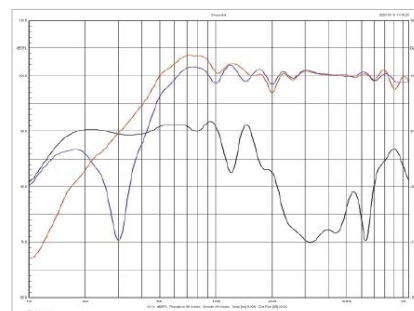
In this voltage range, and even at slightly lower voltages, up to 10 V, Qts remains in the range of 0.2-0.3. Lowering the voltage to 6 V (green curve) results in a clear decrease in level across most of the band



**fig. 9. Vigo EX, low-frequency response - separately speaker, opening and resultant radiation at a voltage of 15V to the electromagnet.**

(about 6 dB compared to 15 V), while there is a local boost at 70 Hz, the peak of which lies even higher than before - this is the effect of bass-reflex operation at high Q factor (Qts about 0.5), and the prominence will be accompanied by a weak impulse response.

The next figure breaks down the resultant responses into „prime factors" - the radiation of the speaker and the port. For this analysis, we chose the 15 V version. The pronounced speaker off-loading at 37 Hz indicates the enclosure's resonance frequency, resulting from the "operation" of a Helmholtz (bass-reflex) resonator rather than a quarter-wave resonator - for this frequency the tunnel would have to be much longer; labyrinth resonances are visible - simultaneously as dips in the driver response (blue) and peaks on the characteristic from the port (black curve)



**fig. 10. Vigo Classic, low frequency response - loudspeaker, opening and resultant radiation separately.**

at 120 Hz and 200 Hz; at the end of the curve there is a peak at approximately 1 kHz, which is likely resonance of a section of the tunnel. For such an unusual enclosure, these are partly just speculations and not 100% certain.

A similar analysis of the Vigo Classic shows slightly different characteristics; in fact, the measured impedance values indicated a lower bass-reflex tuning; apparently the internal layout of the enclosure is the same, but in the tested unit, made of MDF (the current production ones are supposed to be made of plywood, like the Vigo EX), the bass-reflex ports were clearly different - the rear port on the Vigo Classic was 25 cm x 2.5 cm, while in the Vigo EX it was 28 cm x 8 cm.



**We tested broadband speakers many years ago, with rather inconclusive results. There aren't many of them on the market, nor did I become a fan of them, so I didn't have to make any special dodges to not test them again until now.**

**However, something "happened"...**

## LISTENING

Broadband speaker performance is a mystery. Although the design is technically simple (which does not mean that it is not sophisticated), the frequency response is complicated - after all, it carries a lot of unevenness, they boost and weaken wider and narrower ranges, limit the highest frequencies, narrow their dispersion... Based on the measurements, you should expect to hear - for better or worse - sound that is improvisational, creative, fractured, unnatural, distorted, incorrect... and multifaceted, rich, unusual and that requires some getting used to. But when I heard the Vigo for the first time 2 years ago at the Audio Show - the impression was not only excellent but also unexpected. Their clarity, openness, ease, communicativeness, intimacy, immediacy, and seamless perception of music and emotions pushed aside the lack of neutrality. Having already had encounters with broadband speakers, the experience of coherence was not as shocking, but it really puzzled me how even the treble seemed sufficiently complete, even optimal. After all, I saw what I was listening to - a 12-inch speaker.... And it was this meeting with Vigo and their designer Jacek Grodecki was the beginning of a formal test, which has just come to fruition.

Testing broadband loudspeakers at AUDIO is a somewhat risky undertaking. It is impossible to avoid confrontation with measurement results, which puts a question mark on the promotional value of the test. All the more so if we assume that the measurement results also influence the listening report, when the reviewer wants to avoid

confusion and tries to make one thing agree with another. At the same time, he is always under pressure not to kick the product he is testing....

In this case, I had no doubts and did not want the manufacturer to have any. I won't take back my praise for the sound, even when I see poor measurements, although we'll show those too. Let each reader draw his or her own final conclusions, preferably after a personal encounter with that unusual sound. We still do not know all the phenomena, the correlation between the response and our perception, the influence of predisposition, habits and attitudes, all the complicated dependencies that also occur with time (and are most often attributed by audiophiles to the process of warming up the equipment). This is where our competence ends, and some questions are left open... especially the most prosaic and important one: To buy or not to buy? Are these the speakers for me?

Both versions of the Vigo - Classic and EX - were delivered for testing, along with a pair of optional tweeters which we treated as an add-on to the EX and listened to the tweeters only with them. We later learned that this was an option for both Vigo models. So, the test isn't 100% complete since we can't report on how the Classics sound with the tweeter, but I think we can live with that and adequately predict their performance based on our tests and impressions of the EX version. We had to test many variations, because the EX version is equipped with an adjustable electromagnet, which affects not only the efficiency and hence the volume level, but more importantly the parameters determining the processing and impulse characteristics in the low frequency range.



However, let's start with the Vigo Classic, without any additions or adjustments. The test taking place in a much larger room allows us to see that these speakers do not require such conditions to spread their wings.

They already sounded very good in the small suite at the Sobieski Hotel, when I sat in front of them at a distance of about 3 meters;

the bass was not boosted at all (which some might fear at the sight of the 12-inch), and the whole was very well focused (unsurprising due to the single driver). Now, in

about 40 square meters, with the speakers placed about 2 m away from the walls,

the sound is concentrated in the midrange, there is less bass, but good saturation ensures the creation of large apparent sound sources, with "presence".

Vigo Classic transports us to another world but doesn't force us to acclimatize for a long time - we immediately feel comfortable and safe in it. It is a sound that is both very engaging and comfortable. It's not a perfect world, with all the information arranged exactly according to the recording, but it's engaging with the sounds at least seeming more natural.

I have heard multiway speakers with treble that measured better, which either sounded darker, sad, muffled, trodden down, or had screaming midrange, without a breath of air. It's not hard to determine that the Vigo Classic's treble ends early, closes in, and has neither strong sparkle nor ethereality, yet we ignore these limitations almost immediately. Even an experienced audiophile may be a bit confused; he will know that his focus is on the midrange and the treble is subordinate, he can name these ranges and relationships, but with his ear he will no longer track localized unevenness. A less educated listener, not burdened with the habit of analytical observation of the sound in terms of established criteria, will perceive the sound as coherent, harmonious, close, not bothered by any theoretical shortcomings. And if anything, they will complain rather about the bass - less powerful than promised by the use of a 12-inch driver. By contrast, anyone who knows even a little about loudspeaker technology will be amazed at any treble presence.

If the Vigo Classic had a higher reaching frequency response, maybe it would sound even better or at least not worse... But even as it is - it is at least good. And even very good, if we take into account all impressions, which have other reasons than just a specific shape of the frequency response.

We can praise the clarity of bass, which is also important for the clarity of midrange frequencies. The bass goes quite low, has rich and natural textures, combines selectivity with fluidity and coherence, and freedom with delicacy. What's very nice is that there's no rumble weighing on it, which would even be justified from such a large enclosure, but its unique internal layout apparently does its job in taming standing waves as well.

**How to reconcile naturalness with limiting and undulating frequency response - only the... the best broadband speakers and the sense of hearing know.**



**The Vigo EX introduces unusual (for typical speakers) possibilities of adjusting bass character, but it should be made clear that this does not mean opening up an infinite palette of sounds.**

With lower levels of the whole sound the bass simultaneously emphasizes and softens, with higher levels it becomes springy, then hard and dynamic, more vibrating than massaging. These changes affect the overall proportions and therefore the role and timbre of the midrange, but regardless of the level, a rather constant difference from the Vigo Classic was a more pronounced midrange presence and harder tones. The Vigo Classic's coloration is somehow tamed and integrated, but in any case, the Vigo Classic remains for me a speaker that plays more pleasantly, warmer and softer (yet still lively and close), while the EX lets you hear more detail.

Adding a tweeter has very controversial effects. I am not playing at diplomacy and the word "controversial" has a literal meaning here. It doesn't replace the word "undesirable" but implies the possibility of different evaluations by different users. But how do I know this if I only use my hearing in the test? I can also use my imagination in my conclusions, and that imagination is always based on some experience. As a matter of fact, many readers have already guessed what will happen next. Adding the tweeter not only completes the presentation but also changes its color; it does not emphasize treble over the midrange level, but it sounds a bit etched. However, there is a sharpness, an additional coloration that attracts attention. While earlier the sound boasted excellent coherence, which translates into high musical communicativeness, with the tweeter the sound becomes "complex", providing significantly more detail... But the operation of tightening up the treble here is not as easy as in conventional, multi-way speaker

assemblies, where good tuning of the tweeter (and the entire crossover) gives a smooth transition and a simple gain of better response extension. Here some "scar" remains, the sound is no longer so coherent, the treble plays a bit independently... This is no longer a noble, albeit limited sound of a broadband speaker. The matter is complicated by the ambiguity of the recommended polarity of the tweeter connection, which is further explained in the laboratory.

I'm not disqualifying the addition of a tweeter, but I don't consider it an addition that is either necessary or guaranteed to improve the sound. I would certainly recommend testing for yourself whether it's to your individual taste. If such a test is not possible or will not provide certainty then as long as cost does not play a major role, it can be bought and then easily connected and disconnected, having both variants at hand. The situation would be more difficult if there were separate designs with integrated tweeters - the choice would be zero-one and after the purchase we would be doomed to one sound option. My greatest affection and appreciation remains with the basic version of the Vigo Classic, with no extras.



In the test I had to face the measurement results, which show serious imperfections in the audio characteristics, but I will not revoke my praise for the sound and repeat what I wrote in the Audio Show review - these are the best broadband speakers I have ever met. I haven't heard them all, and most importantly, I do not claim that that this is the best sound in an absolute scale, but in a "genre" related to a technique that carries a specific set of advantages and disadvantages. If I were to create a collection of loudspeakers with character that I would want to listen to from time to time, the Vigo Classic would be in it.

### CLOSER ACOUSTICS VIGO CLASSIC

**PRICE** 41 000 PLN\*  
**DEALER** CLOSER Acoustics  
[www.closeracoustics.com](http://www.closeracoustics.com)

#### DESIGN

Original in every respect - the external form of the cabinet, its internal structure, the concept of a one-way system with a 12-inch broadband driver.

#### MEASUREMENTS

Gain in the 2-7 kHz range, drop above, wide midrange dispersion. Good bass descent (-6 dB at about 40 Hz). High impedance - rated 12 ohms, high efficiency - 95 dB.

#### TONE

Close, direct, communicative, lively, emotional. They bring you into the mainstream of music, effectively moving your attention away from tonal deficiencies and treble limitations. The bass is well developed and carried, not exaggerated, clear and vivid.

### CLOSER ACOUSTICS VIGO EX

**PRICE** 64 600 PLN\*  
**DEALER** CLOSER Acoustics  
[www.closeracoustics.com](http://www.closeracoustics.com)

#### DESIGN

All the virtues of the Vigo Classic, plus a loudspeaker with an electromagnet instead of a permanent magnet. Labyrinth cabinet made entirely of plywood.

#### MEASUREMENTS

At maximum voltage (supplying the electromagnet) the characteristics are similar to those of the Vigo Classic. Rated impedance 8 ohms, efficiency 95 dB, parametrically great for amplifier.

#### TONE

Adjustment of solenoid power can ultimately change the proportions of - emphasize bass at the expense of midrange, but the best results appear in the vicinity of the parameters of the Vigo Classic. Regardless, the EX's sound seems harder and more detailed.

\*Price of a pair of the tweeters - 3100PLN

The addition of a tweeter in the offering hints that the Vigo's broadband driver processing is not perfect; its performance, both proprietary and measured, also informs this. I guess even the biggest fans of single-way systems are prepared to compromise in this area - processing the highest frequencies through a 12-inch speaker is unlikely... One can take the sobering view that if the other sonic advantages of a one-way system win out in the overall impression, creating a sound that is more natural than that derived from multi-way systems, then we are agreeing to some limitations. However, if we decide that in order to remove these limitations we need to add a tweeter, then we abandon the one-way system and move to a two-way one. Even if specifically tuned, it is already a two-way system. Then we cannot count on the earlier arguments in favor of a one-way system to pay off... So what was the point of going so far if we gave up in the end? In terms of the main idea, so strongly emphasized, it is indeed a failure, but we are not losing everything at all.

**This arrangement - Vigo plus tweeter - also makes sense, except that it's different now. These are unique advantages and... new problems.**

First, efforts to prepare a wideband 12-inch driver, while not ensuring processing of the entire acoustic bandwidth, resulted in a woofer that can work in two-way systems, not just three-way (as the vast majority of 12-inchers do). Secondly, since the characteristics of the LB12 (both versions) reach up to 7 kHz (on the main axis, according to our measurements), taking that into account, we can set a high dividing frequency and be glad that at least some of the advantages of a one-way system are saved - the additional tweeter processes only the "end" of the band, while the main driver still deserves to be called broadband; It is not low-pass filtered, so there are no additional

The tweeter is mounted on the top wall via an acrylic transparent "stand" with a profile that matches the curve of the Vigo's top wall.



phase distortions on this side, and shifting the dividing frequency far beyond the midrange - where our hearing is most sensitive to any distortion - largely reduces the problem of assumed "inconsistency" of the sound of multi-way systems.

For such application, as a supplement to the LB12, EMS company has prepared a special tweeter with the symbol TW4. It has cone cellulose diaphragm of fairly large (for a tweeter) diameter of 6 cm, with a fixed phase corrector in the center, a short horn and a damping chamber (these elements are turned from solid wood). According to the manufacturer's specifications it is supposed to process the 7-20 kHz range, so we should not even try to load it with lower cutoff frequencies, and at 7 kHz cutoff use 2nd order filter or 1st order filter with only 0.47 mF capacitor, which sets theoretically even higher cutoff frequency.

The high split frequency means that the drivers have to work together in the very short wavelength range. This translates into a weakness of directional characteristics in the vertical plane. With a slight change in the angle of the listening (measurement) axis, the phase relationships of the waves running from both drivers are severely altered. The situation is exacerbated by a large dispersion of the acoustic centers of both drivers,



The optional tweeter has a cone, cellulose diaphragm, with phase correction. While these are not features of a typical modern tweeter (much less a supertweeter...), they seem to fit the specifics of a wideband.



Closer chose the 1st order filtering option, with a 0.47 mF capacitor, recommended by the manufacturer of both drivers themselves.

resulting both from a large diameter of the broadband driver, as well as the place of installation of the tweeter, located on the top wall. For the matter at hand it would be better to mount it directly above or even below the broadband, at the front of the enclosure, but that is not possible due to the overriding concept of "optionality" of the tweeter.

Second (who still remembers where "first" was?...), the two-way Vigo plus tweeter system remains with the specific advantage of Vigo itself - high efficiency and high impedance, so it is a good proposition for users of low-power tube amplifiers; there are not many speakers with such parameters on the market. We are using here a certain, already mentioned, tradition in which broadband speakers usually have above average efficiency - that is how speakers were designed half a century ago...



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